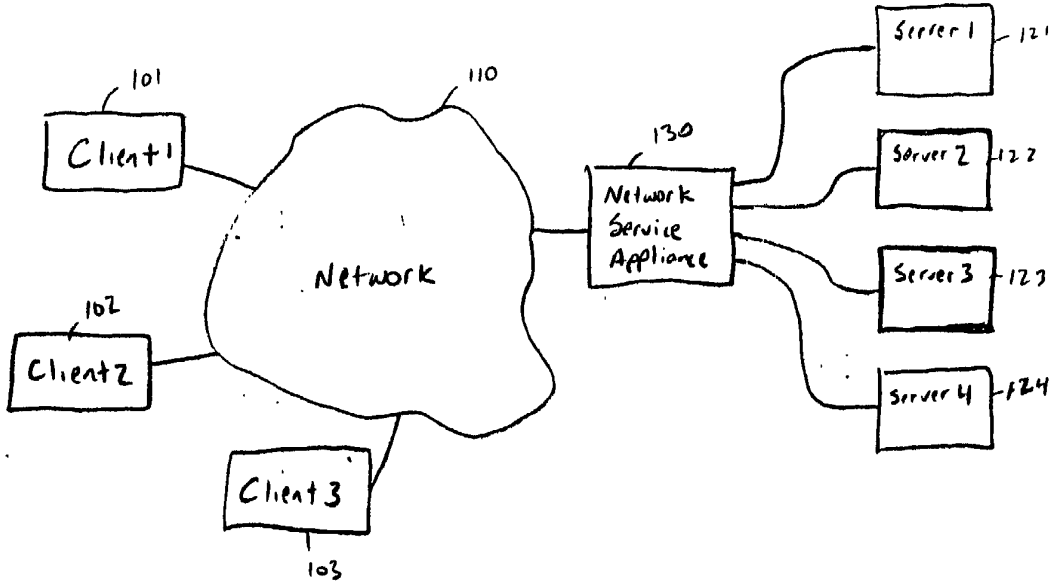
101
110
130
Client 1
Network
Network Service Appliance
Server 1
121
Server 2
122
Server 3
123
Server 4
124
102
Client 2
Client 3
103

Figure 1

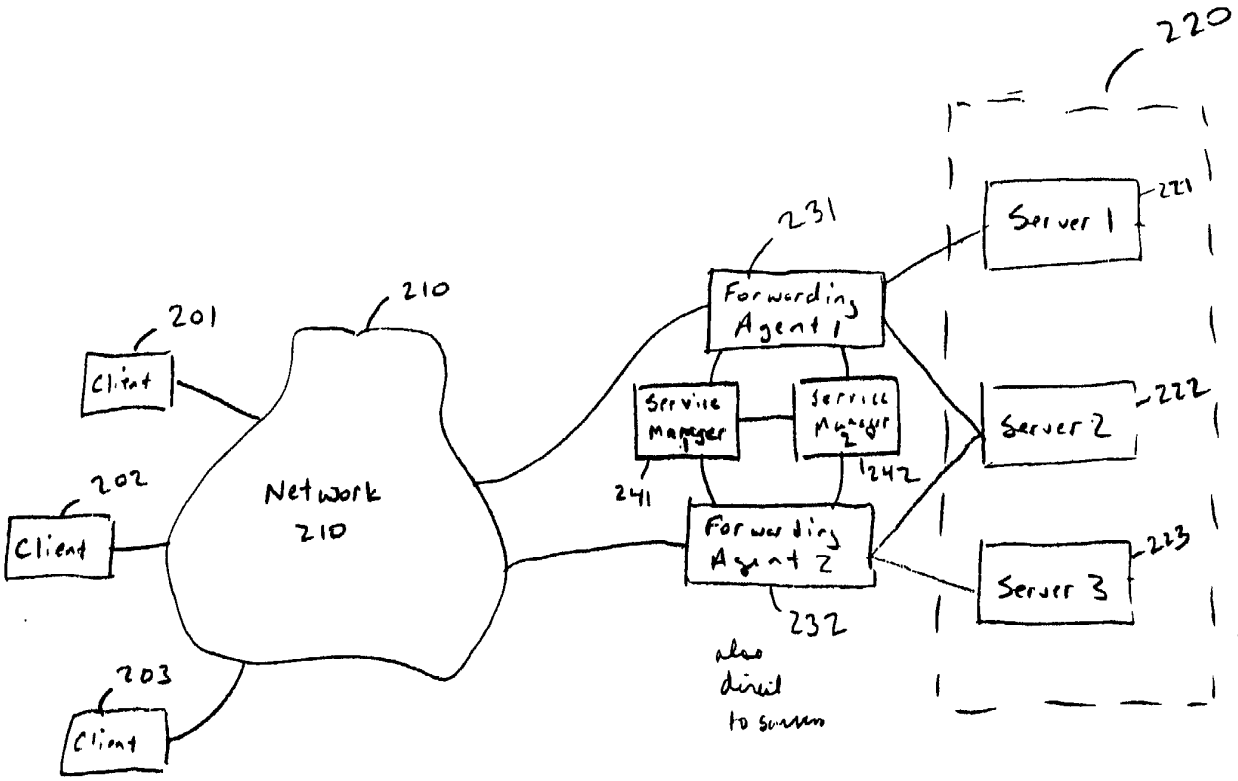
220
Server 1
221
231
Forwarding Agent 1
210
201
Client
Service Manager 1
Service Manager 2
222
Server 2
Network 210
241
242
202
Client
Forwarding Agent 2
223
Server 3
232
also direct to server
203
Client

Figure 2A

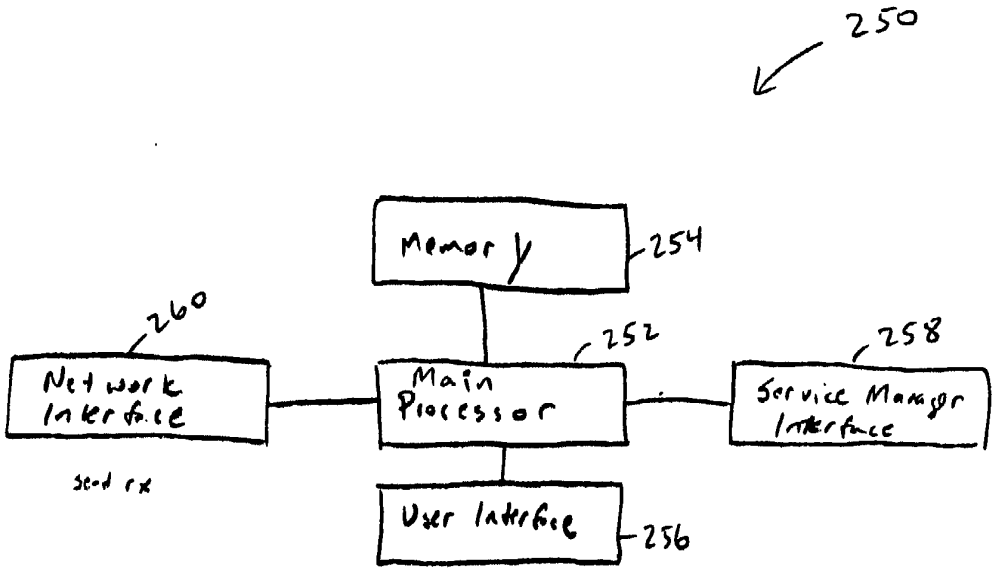
250
Memory
254
260
252
258
Network Interface
Main Processor
Service Manager Interface
xcvr rx
User Interface
256

Figure 2B

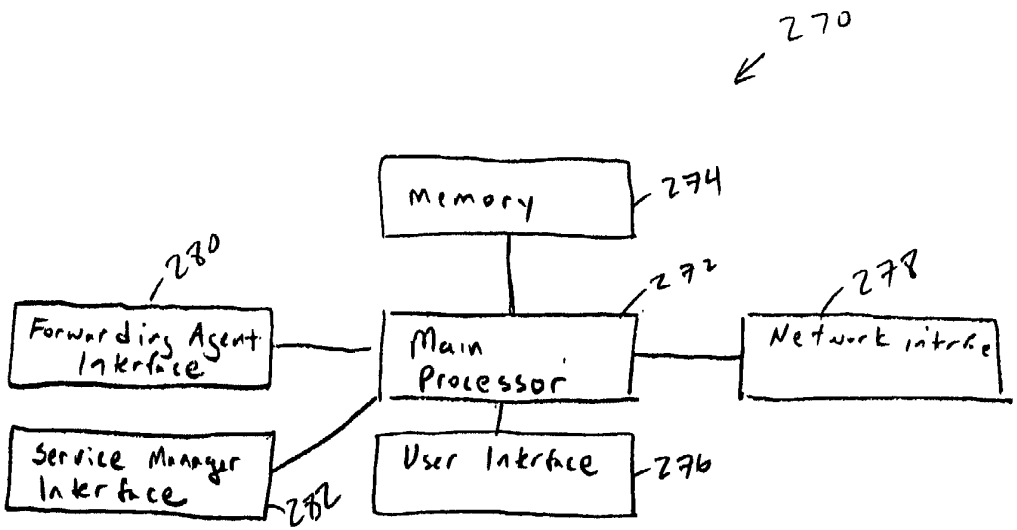
270
Memory
274
280
272
278
Forwarding Agent Interface
Main Processor
Network Interface
Service Manager Interface
User Interface
276
282

Figure 2C

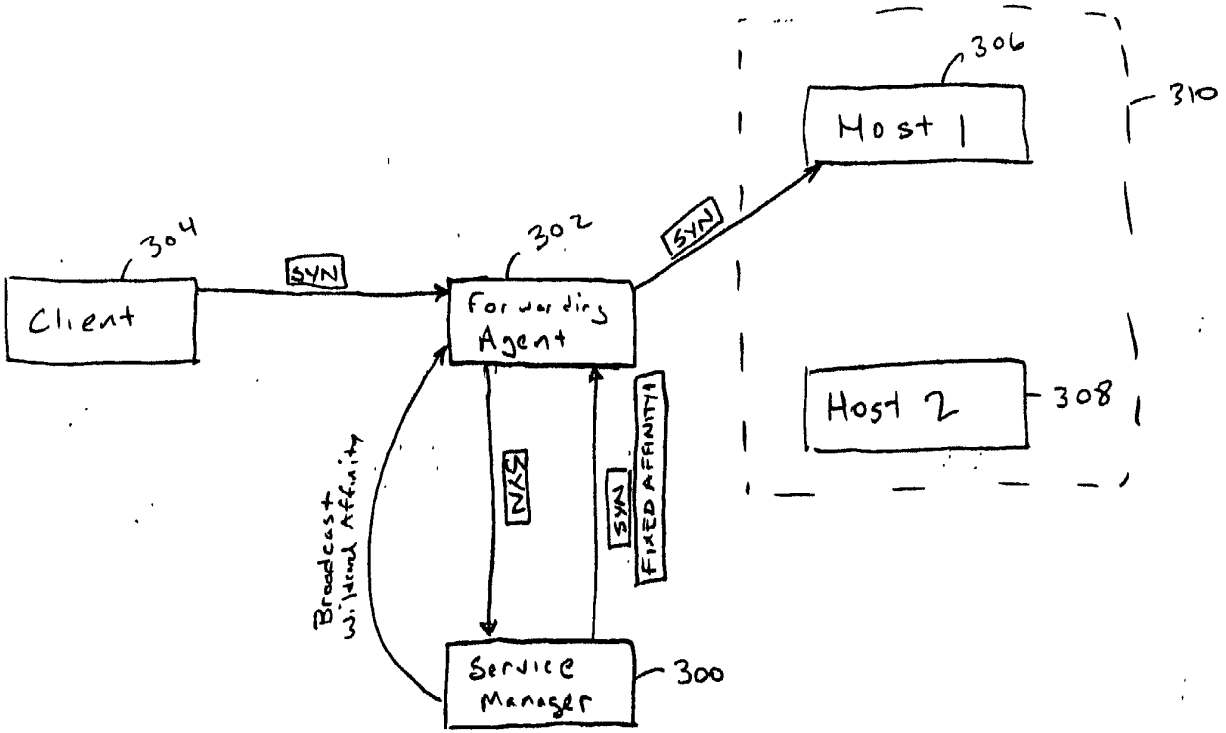
Client
304
SYN
Forwarding Agent
302
SYN
Host 1
306
310
Host 2
308
Broadcast w/ Hint Affinity
NAS
SYN
FIXED AFFINITY
Service Manager
300

Figure 3A

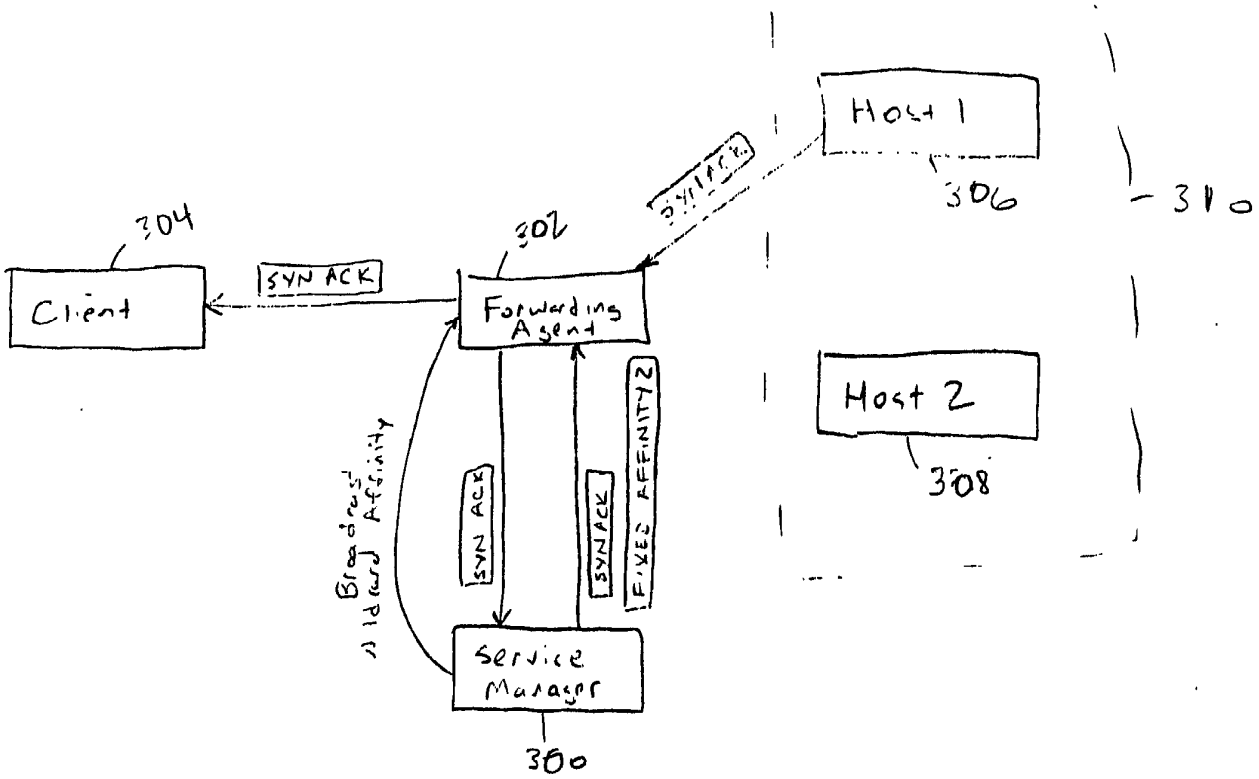
Host 1
306
310
304
302
SYN ACK
Client
SYN ACK
Forwarding Agent
Host 2
308
Broadcast Forward Affinity
SYN ACK
SYN ACK
FIXED AFFINITY2
Service Manager
300

Figure 3B

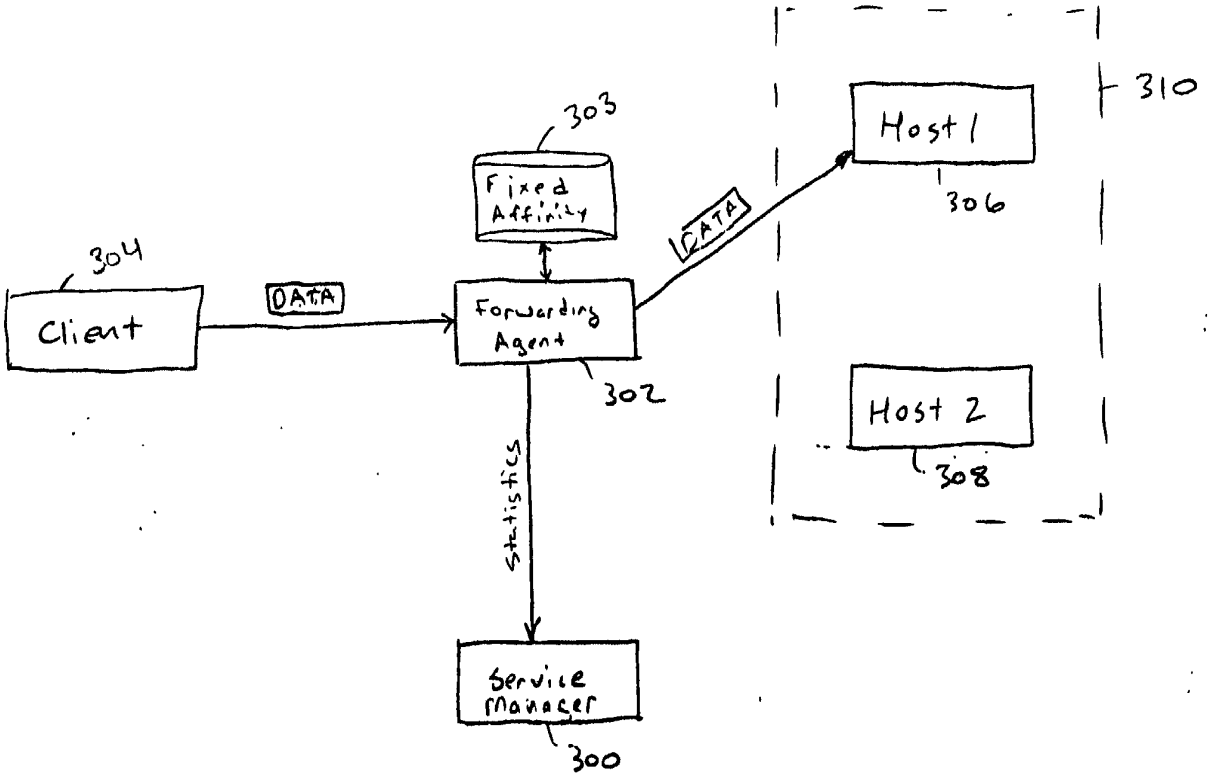
303
Fixed Affinity
304
Client
DATA
Forwarding Agent
302
DATA
Host 1
306
310
Host 2
308
statistics
Service Manager
300

Figure 3C

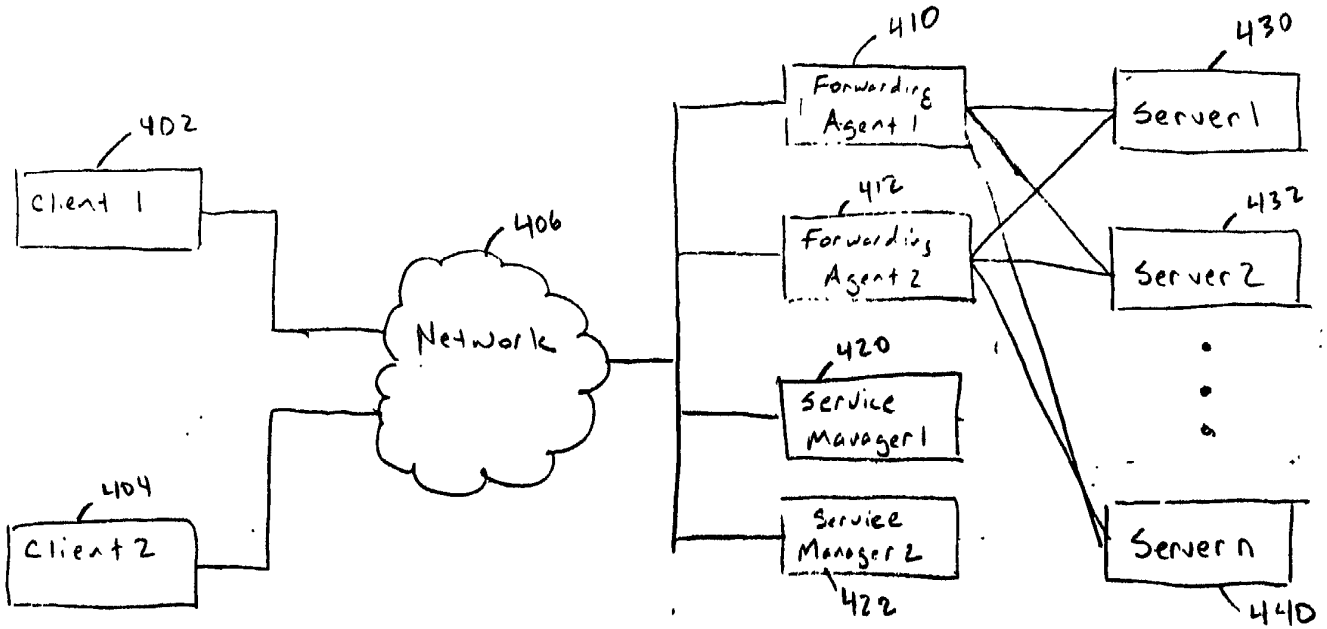
402
Client 1
404
Client 2
406
Network
410
Forwarding Agent 1
412
Forwarding Agent 2
420
Service Manager 1
422
Service Manager 2
430
Server 1
432
Server 2
440
Server n

Figure 4

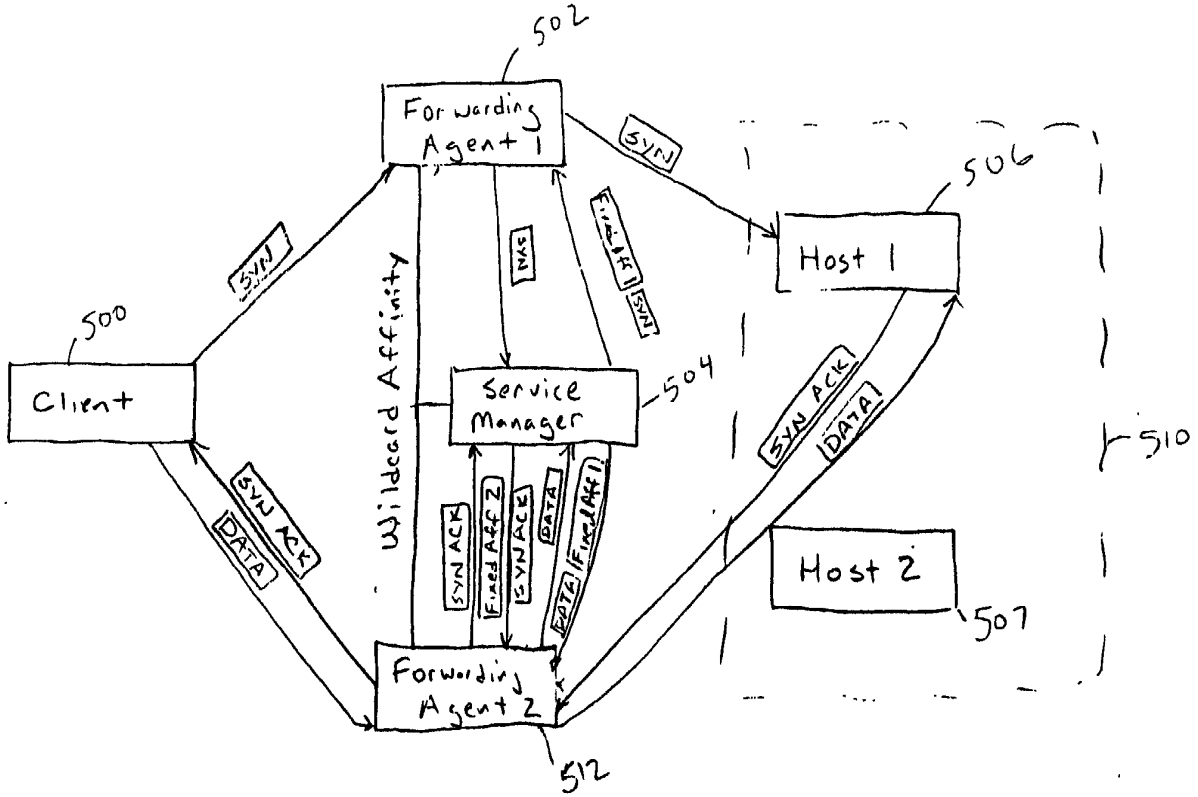
502
Forwarding Agent 1
SYN
506
Host 1
SYN
Wildcard Affinity
SYN ACK
FIN
500
Client
Service Manager
504
SYN ACK
DATA
SYN ACK
DATA
SYN ACK
DATA
510
Host 2
507
Forwarding Agent 2
512

Figure 5

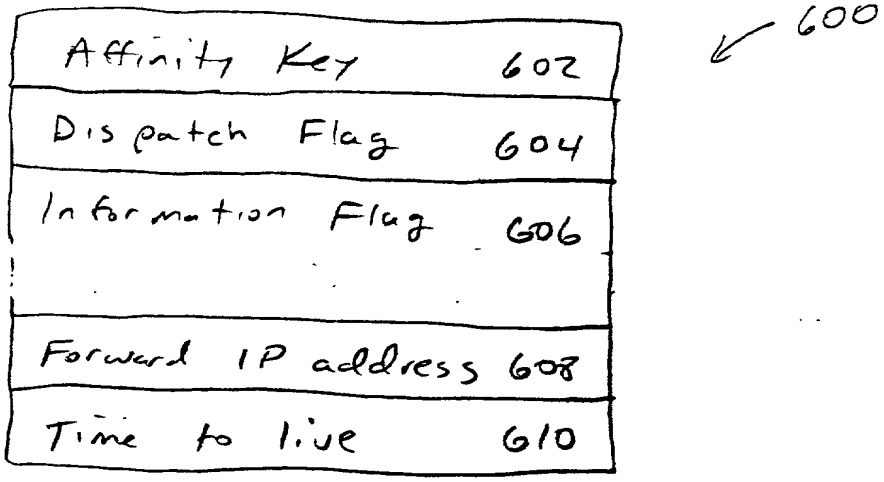
Affinity Key 602
Dispatch Flag 604
Information Flag 606
Forward IP address 608
Time to live 610
600

Figure 6

700

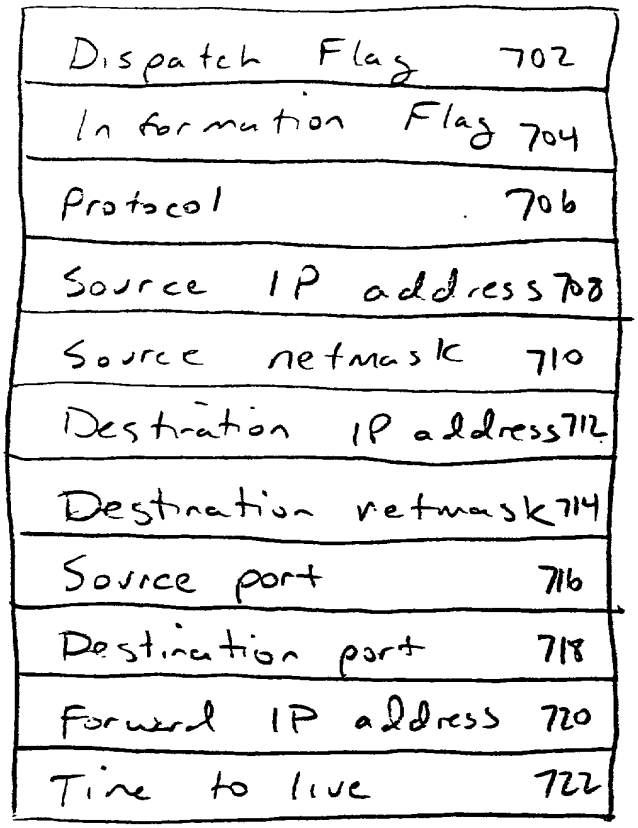
Dispatch Flag 702
Information Flag 704
Protocol 706
Source IP address 708
Source netmask 710
Destination IP address 712
Destination netmask 714
Source port 716
Destination port 718
Forward IP address 720
Time to live 722

Figure 7

Docket: 99-1-1450

800

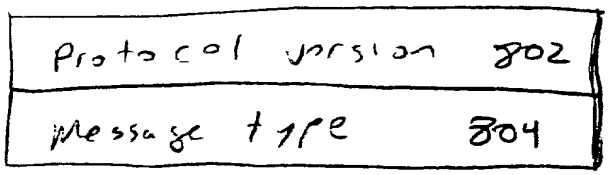

Figure 8A

810

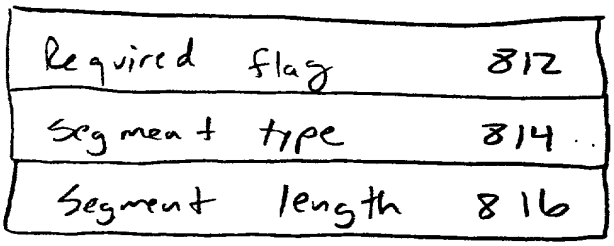

Figure 8B

820

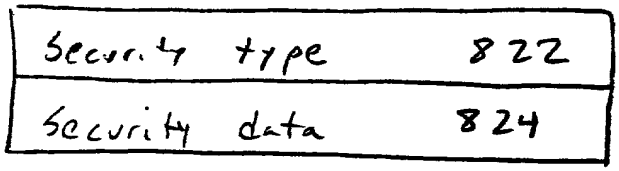

Figure 8C

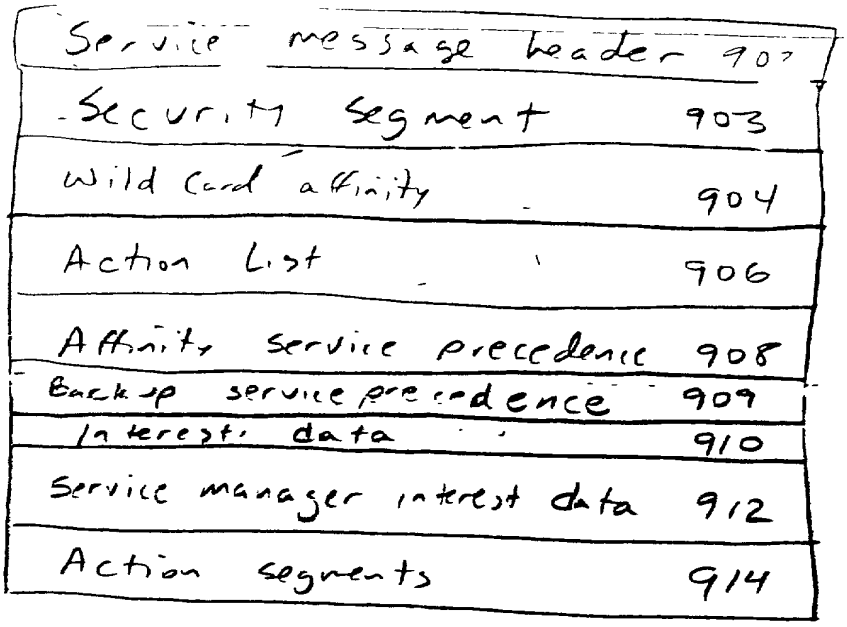

Figure 9A

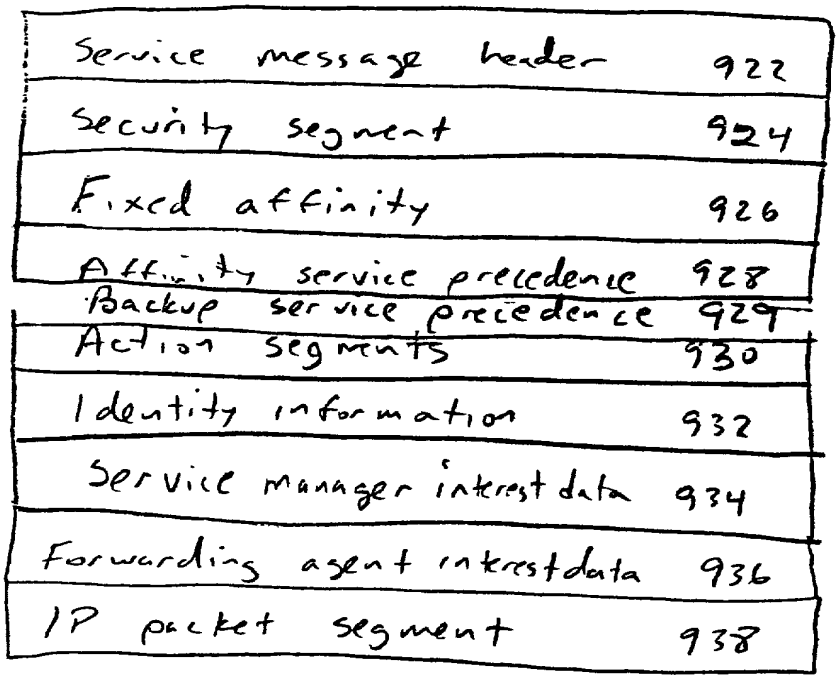

Figure 9B

Service message header	941
Security segment	942
Action list segment	944
Affinity Segment (from original affinity)	946
Identity information (from original affinity)	948
Service manager interest data	950
Forwarding agent interest data	952

940

Figure 9C

Service message header	962
Security Segment	964
Affinity Identifier	966
Identity information (from original affinity	968
Service manager interest data	970
Forwarding agent interest data	972
IP packet Segment	974

960

Figure 9D

Service message header	982
IP packet segment	984

980

Figure 9E

1000

Dispatch Flag	1002
Information Flag	1004
Affinity key	1006
Interest mask	1008

Figure 10 A

1010

Search order Flag	1012
Precedence value	1014

Figure 10 B

1020

Service Manager Interest Data	1021

Figure 10 C

1022

Forwarding Agent Interest Data	1023

Figure 10 D

1024

IP address of Sender	1025
Character hostname	1026

Figure 10 E

1030

Source IP address	1032
Destination IP address	1034
Source port	1036
Destination port	1038

Figure 10F

1040

Sequence delta	1042
Initial sequence number	1044
Acknowledgment delta	1046
Initial Acknowledgment number	1048

Figure 10G

1050

Advertise address	1052
Subnet mask	1054

Figure 10H

1060

Interest IP Address	1062
Interest Port	1064
Interest Mask	1066
Data Flag	1067
Copy Flag	1068
Hold Flag	1069

Figure 10I

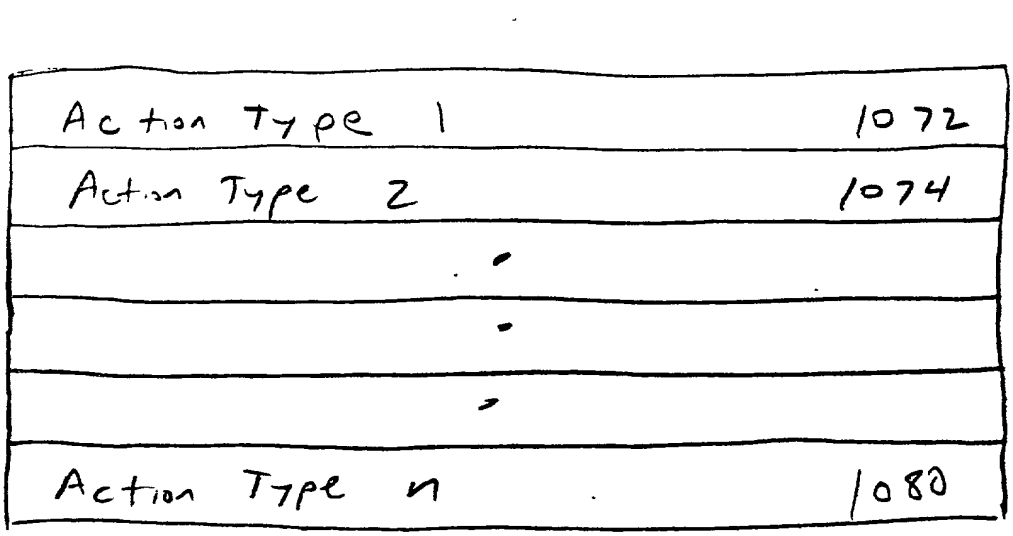

Figure 10J

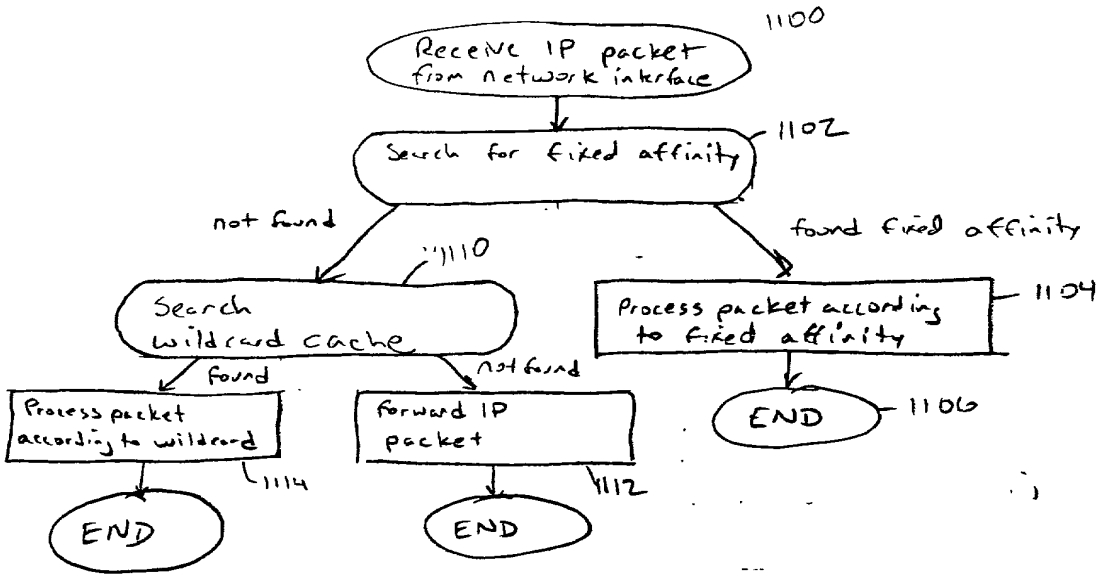
1100
Receive IP packet from network interface
1102
Search for fixed affinity
not found
found fixed affinity
1110
Search wildcard cache
1104
Process packet according to fixed affinity
found
not found
Process packet according to wildcard
Forward IP packet
END
1106
1114
1112
END
END

Figure 11

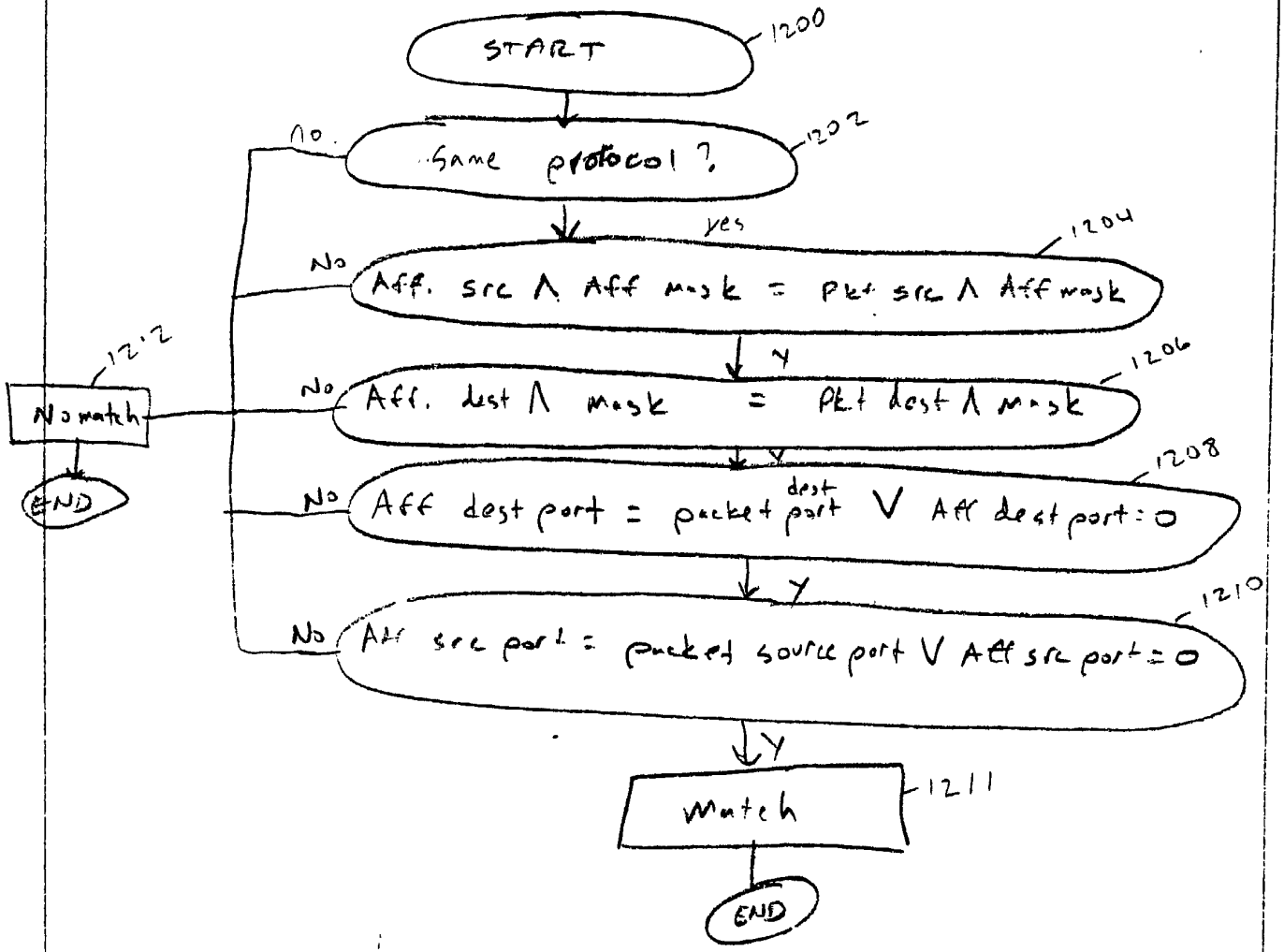
START
1200
Same protocol ?
1202
No
yes
Aff. src ∧ Aff mask = Pkt src ∧ Aff mask
1204
No
Y
Aff. dest ∧ mask = Pkt dest ∧ mask
1206
No
Y
Aff dest port = packet dest port ∨ Aff dest port = 0
1208
No
Y
Aff src port = packet source port ∨ Aff src port = 0
1210
No
Y
Match
1211
END
No match
1212
END

FIG. 12

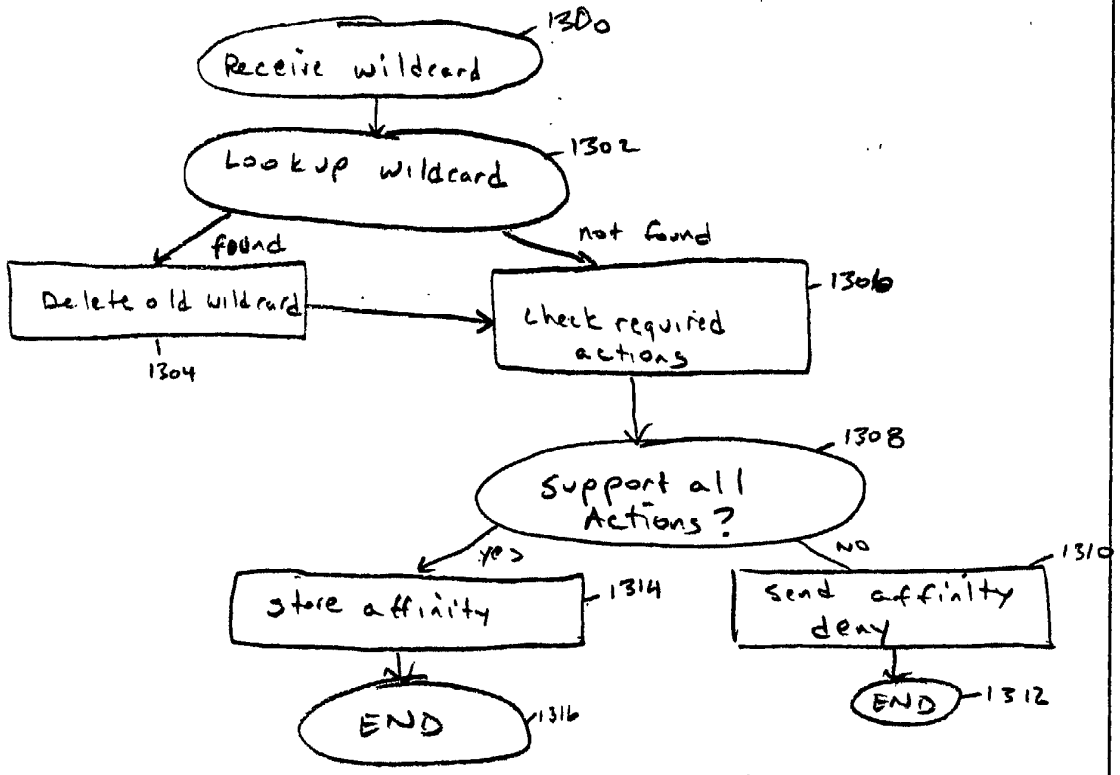
1300
Receive wildcard
1302
Look up wildcard
found
not found
Delete old wildcard
1304
1306
Check required actions
1308
Support all Actions?
yes
NO
1310
Store affinity
1314
Send affinity deny
END
1316
END
1312

FIGURE 13

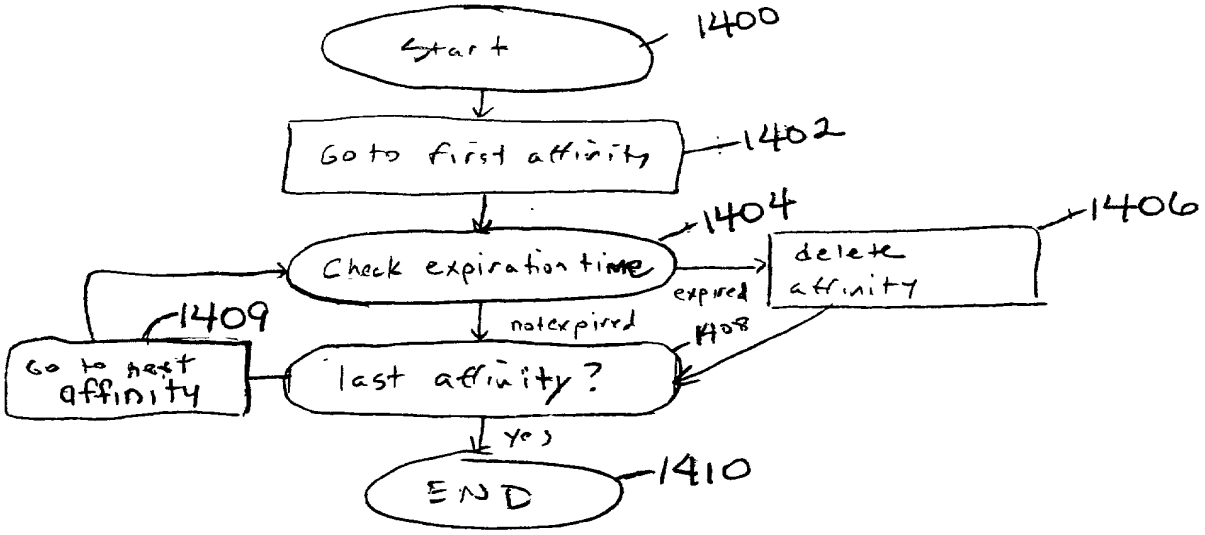
Start
1400
Go to first affinity
1402
Check expiration time
1404
delete affinity
1406
expired
not expired
1408
Go to next affinity
1409
last affinity?
yes
END
1410

FIGURE 14

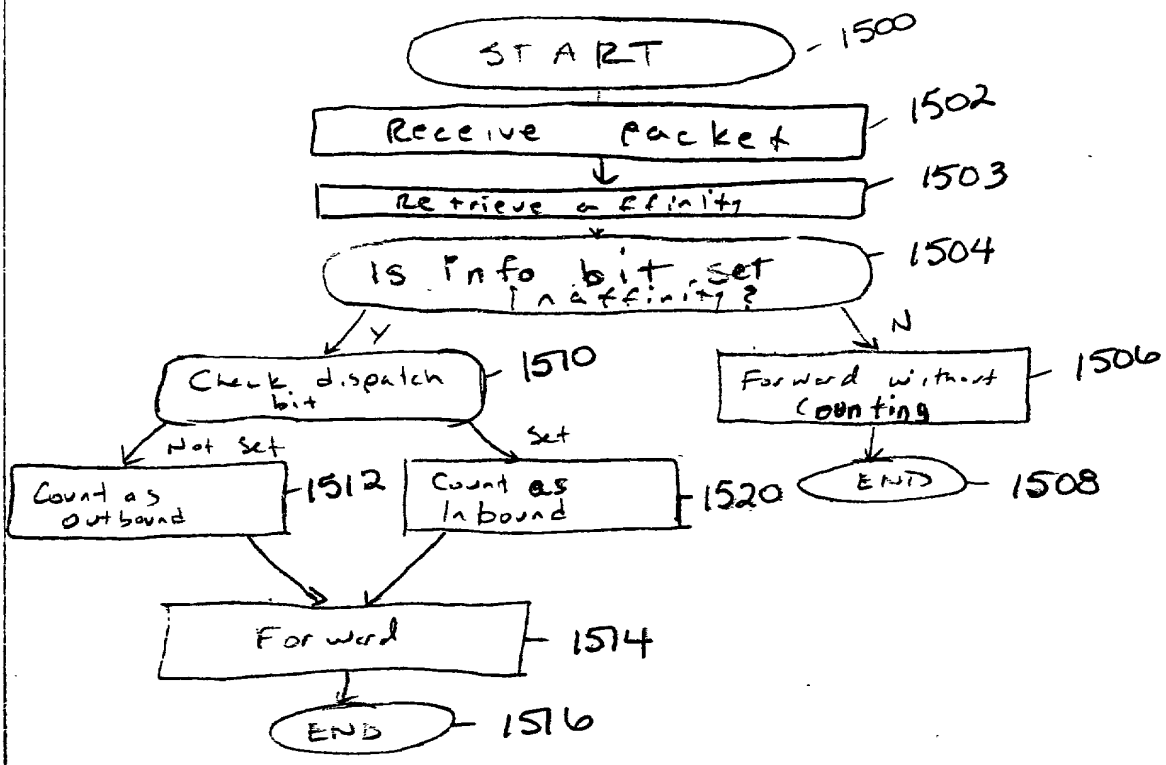
START
1500
Receive packet
1502
Retrieve affinity
1503
Is info bit set in affinity?
1504
Y
N
Check dispatch bit
1510
Forward without counting
1506
Not Set
Set
Count as outbound
1512
Count as inbound
1520
END
1508
Forward
1514
END
1516

FIGURE 15

Forwarding Address	Info	Dispatch	Action
X	0	X	Dispatch
X	X	0	Count out bound
X	X	X	Count In bound & Dispatch
0	X	X	Count, drop
0	0	X	Drop

FIGURE 16 A

NAT ADDRESS	Info	Dispatch	Action
X	X	X	Count Inbound
X	X	0	Count Outbound
X	0	—	Do not count

FIGURE 16 B

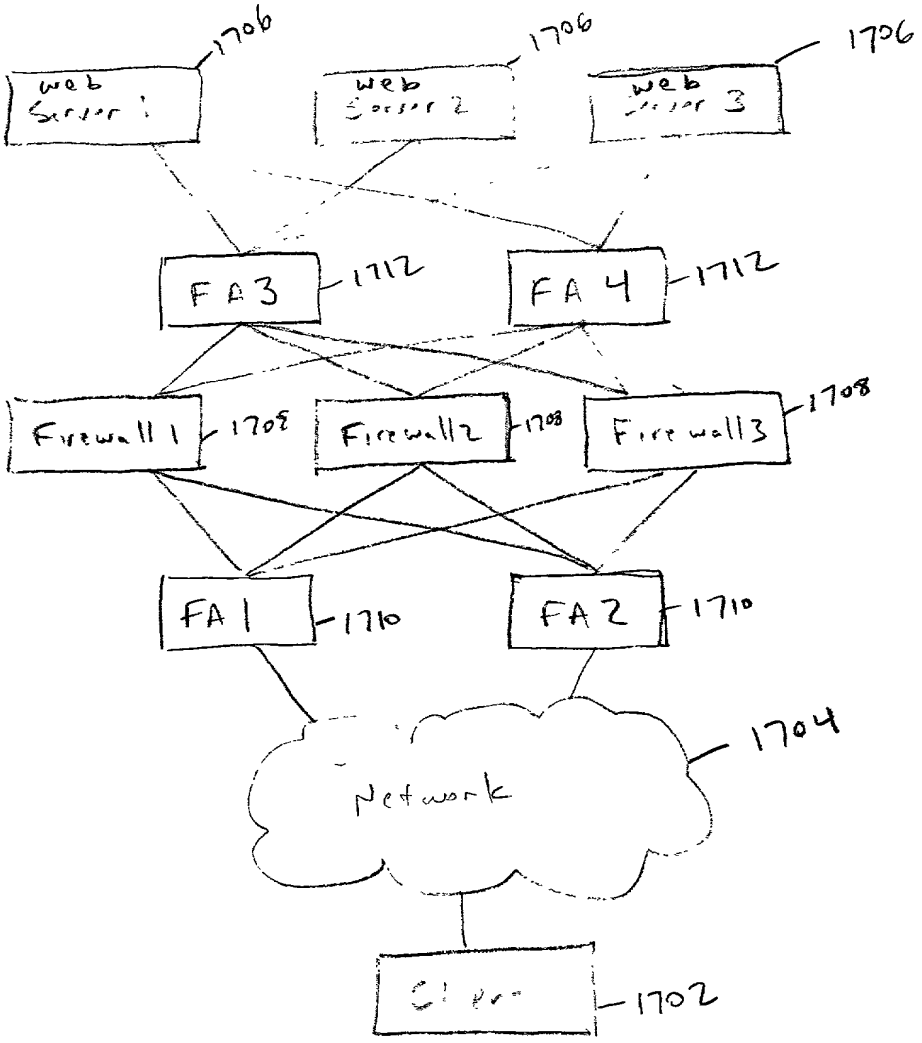
web Server 1
1706
web Server 2
1706
web Server 3
1706
FA 3
1712
FA 4
1712
Firewall 1
1708
Firewall 2
1708
Firewall 3
1708
FA 1
1710
FA 2
1710
Network
1704
Client
1702

Figure 17

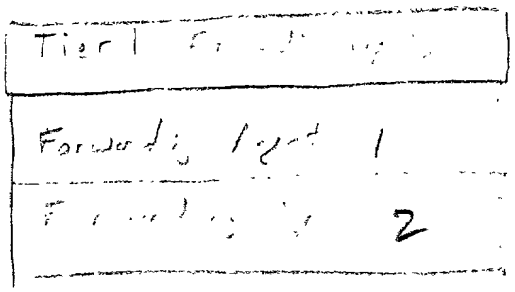

Figure 18 A

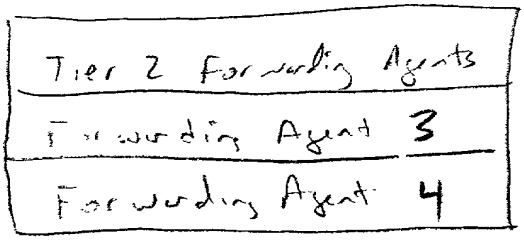

Figure 18 B

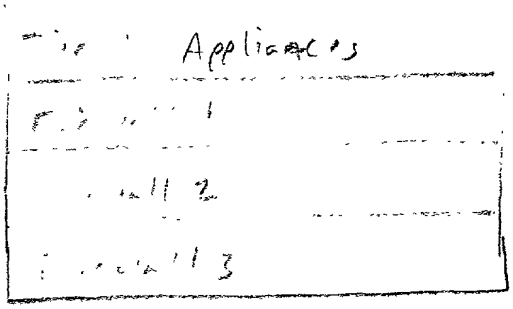

Figure 18C

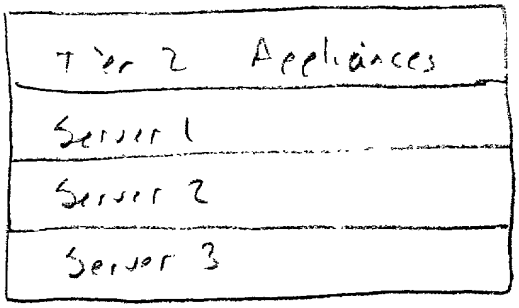

Figure 18 D

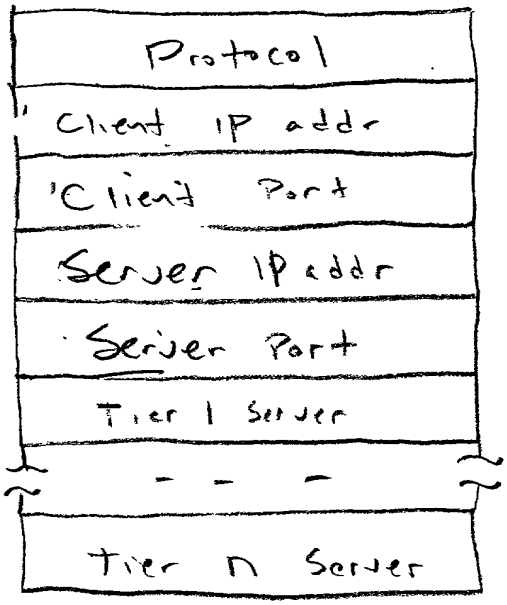

Figure 18 E

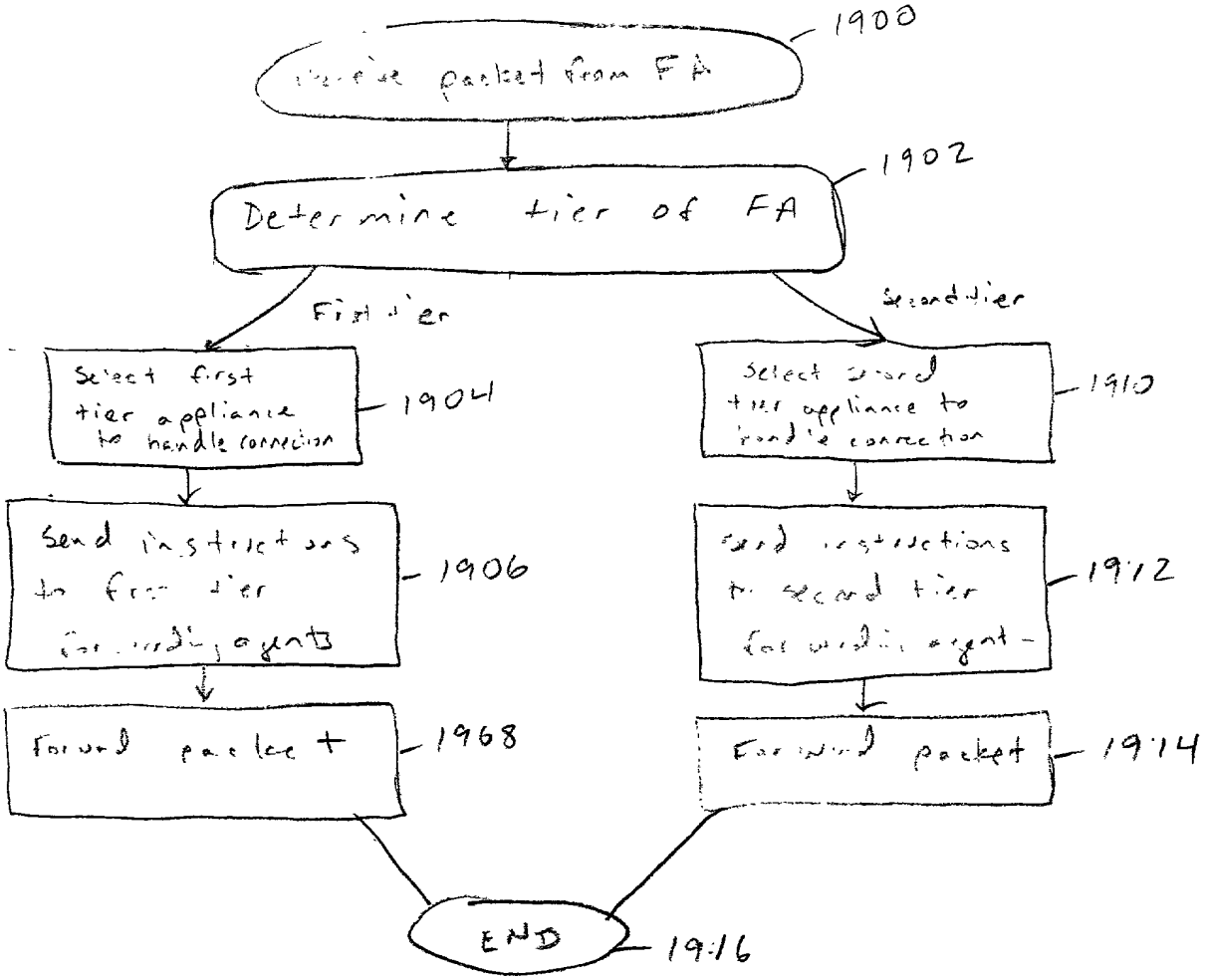
1900
Receive packet from FA
1902
Determine tier of FA
First tier
Second tier
Select first tier appliance to handle connection
1904
Select second tier appliance to handle connection
1910
Send instructions to first tier for forwarding agents
1906
Send instructions to second tier for forwarding agents
1912
Forward packet
1908
Forward packet
1914
END
1916

Figure 19

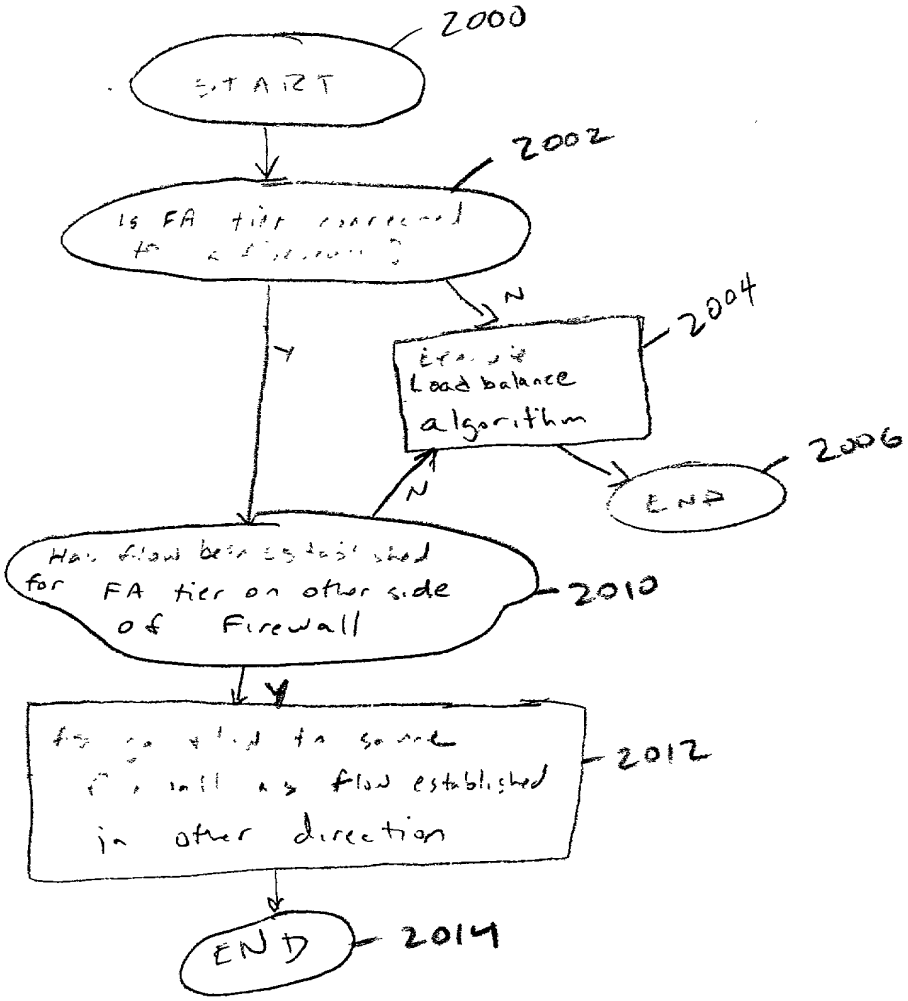
2000
START
2002
Is FA tier connected to a firewall?
N
Y
2004
Execute Load balance algorithm
2006
END
N
Has flow been established for FA tier on other side of Firewall
2010
Y
2012
flow established in other direction
END
2014

Figure 20